

## NISTTech

### Superconducting Transition-Edge Sensor with Weak Links

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#### X-ray sensors for astronomy and materials research applications

##### Description

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The invention involves a modification to highly sensitive resistive thermometers used for precise thermal energy measurements called transition-edge sensors (TES). The design includes a TES with a weak link structure and damping of the electrical bias circuit. The weak link is incorporated into the TES during the fabrication process. A voltage is applied across the sensor, and the resulting current is measured using a current amplifier. The current that flows through the TES is a function of the applied voltage and the temperature. Without the weak links, the current response of the sensor to the voltage and temperature could vary and have steps and glitches, extra noise, and hysteretic.

##### Applications

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- **Thermometer within an x-ray microcalorimeter**  
Measurements of chemical shifts in x-ray spectra caused by changes in electron binding energy due to chemical bonding. Analysis of contaminant particles and defects for the semiconductor industry.
- **Astronomy**  
Determine the temperature and motion of matter in space.
- **Semiconductor materials analysis**  
Help to differentiate between nanoscale contaminant particles on silicon wafers.

##### Advantages

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- **Smoother, quieter, non-hysteretic response**
- **Weak links control the response function of the TES**  
Removes glitches and steps in the output.
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##### Abstract

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A system and method for using one or more localized weak-link structures, and damping on the electrical bias circuit, to improve the performance of superconducting transition-edge sensors (TES). The weak links generally consist of an area or areas having a reduction in cross-sectional geometry in an otherwise uniform bilayer TES applied to a substrate. The weak links control the dissipation of power in the sensor, making it quieter and making its electrical response smoother and less hysteretic. The TES response is also made smoother by implementing a damping circuit on the electrical output of the TES.

##### Inventors

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##### Citations

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1. Please see to additional microcalorimeters:
2. Docket # 94-005, U.S. Patent #5,634,718, Particle Calorimeter with Normal Metal Base Layer
3. Docket # 99-035, U.S. Patent # 6,455,849, Normal Metal Boundary Conditions for Multi-Layer TES Detectors

##### Related Items

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- Article: Copper Ridges Nearly Double X-ray Sensor Performance

##### References

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- U.S. Patent #6,239,431 issued 05-29-2001, expires 11/24/2018
- Docket: 97-040US

##### Status of Availability

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active patent and available for licensing

Last Modified: 12/30/2009